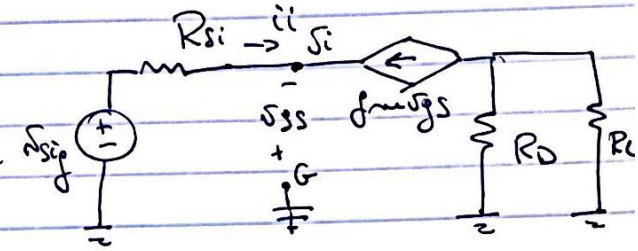
Input resistance

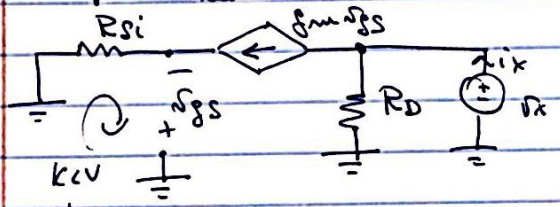
$R_i = \frac{V_i}{i_i}$

$i_i = -g_m v_{gs} \quad \because v_i = -v_{gs}$

$R_i = \frac{1}{g_m}$



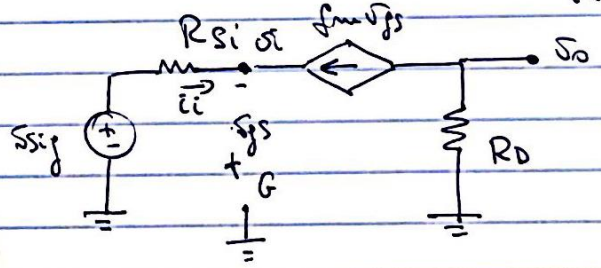
Output resistance



$v_{gs} = -g_m v_{gs} R_{si} \Rightarrow v_{gs} = 0 \Rightarrow g_m v_{gs} = 0 \Rightarrow R_o = \frac{v_x}{i_x} = R_D$

Gain

$A_{vo} = \left.\frac{v_o}{v_i}\right|_{R_L = \infty}$

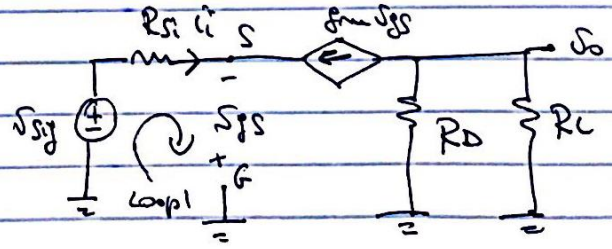


$v_o = -g_m R_D v_{gs}$

$v_{gs} = -v_i$

$A_{vo} = +g_m R_D$

$A_v = g_m (R_D \parallel R_L)$



$G_V = \frac{v_o}{v_{sig}}$

$v_o = -g_m v_{gs} (R_D \parallel R_L)$

KVL @ Loop 1: $v_{sig} = i_i R_{si} - v_{gs}$

$i_i = -g_m v_{gs}$

$$v_{gs} = \frac{-v_i}{1 + g_m R_{si}}$$

$$G_V = \frac{v_o}{v_{si}} = \frac{g_m (R_D \| R_L)}{1 + g_m R_{si}} = \frac{(R_D \| R_L)}{\frac{1}{g_m} + R_{si}}$$